What Is Claimed Is:

1. An apparatus for sampling gas phase molecules, comprising:

   (a) a semi-permeable membrane having a permeate side and sample side;

   (b) a support structure that supports said semi-permeable membrane;

   (c) a vacuum source that generates a reduced pressure at said permeate side of said semi-permeable membrane; and

   (d) an analyzer in fluid communication with said permeate side of said semi-permeable membrane.

2. The apparatus of claim 1, further comprising a heater for said semi-permeable membrane.

3. The apparatus of claim 1, wherein said semi-permeable membrane is a gas-permeable membrane.

4. The apparatus of claim 1, wherein said analyzer is a gas chromatograph.

5. The apparatus of claim 3, wherein said gas-permeable membrane is a polymer.

6. The apparatus of claim 5, wherein said gas-permeable membrane is a tetrafluoroethylene polymer.

7. The apparatus of claim 1, further comprising a trap in fluid communication with said permeate side of said semi-permeable membrane.

8. The apparatus of claim 1, wherein said vacuum source is a vacuum pump.

9. The apparatus of claim 1, further comprising a sample loop in fluid communication with said permeate side of said semi-permeable membrane and said analyzer.

10. An apparatus for sampling gas phase molecules, comprising:

(a) a gas-permeable membrane having a permeate side and a sample side;
(b) a support structure that supports said gas-permeable membrane;
(c) a heater for said gas-permeable membrane;
(d) a vacuum pump that generates a reduced pressure at said permeate side of said gas-permeable membrane;
(e) a sample loop in fluid communication with said permeate side of said gas-permeable membrane; and
(f) a gas chromatograph in fluid communication with said sample loop.

11. The apparatus of claim 10, wherein said gas-permeable membrane is a polymer.

12. The apparatus of claim 11, wherein said gas-permeable membrane is a tetrafluoroethylene polymer.

13. The apparatus of claim 10, further comprising a trap in fluid communication with said permeate side of said gas-permeable membrane.

14. A method for sampling gas phase molecules of a sample, comprising:

(a) placing a semi-permeable membrane having a permeate side and a sample side in fluid communication with the sample;

(b) generating a reduced pressure on the permeate side of the semi-permeable membrane with a vacuum source to draw the gas phase molecules from the sample through the semi-permeable membrane to the permeate side; and

(c) analyzing the gas phase molecules in an analyzer, wherein the analyzer is in fluid communication with the permeate side of the semi-permeable membrane.

15. The method of claim 14, wherein the semi-permeable membrane is heated above ambient temperature.

16. The method of claim 14, wherein said method is used to sample gas phase molecules below a soil surface.

17. The method of claim 14, wherein said method is used to sample gas phase molecules above a soil surface.

18. The method of claim 14, wherein said method is used to sample gas phase molecules above a surface of a liquid.

19. The method of claim 14, wherein said method is used to sample gas phase molecules below a surface of a liquid.

20. A method for sampling gas phase molecules of a sample, comprising:

(a) placing a gas-permeable, heated membrane having a permeate side and a sample side in fluid communication with the sample;

(b) generating a reduced pressure on the permeate side of the gas-permeable membrane with a vacuum pump to draw the gas phase molecules from the sample through the gas-permeable membrane to the permeate side and then to a sample loop; and

(c) analyzing the gas phase molecules in a gas chromatograph, wherein the gas chromatograph is in fluid communication with the sample loop.